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FOOD PROCESSING AND THE DEVELOPING SOCIETY

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FOOD PROCESSING AND THE DEVELOPING SOCIETY

by

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INTRODUCTION

1. For years man has been engaged in finding ways of increasing agricultural output. He has developed dependable and stable sources of food to provide for better living standards. Those countries which have achieved a high level of technological development in food processing have benefited from tremendous economies in food production, conservation, and distribution. Throughout this paper, I will attempt to illustrate these technological, social and economic benefits that have accrued to countries which have developed food processing industries and to relate these experiences to the particular needs and conditions in developing countries.

2. The first section of this paper is a brief discussion of food processing, recent innovations in food technologies and an appraisal of the function this industry has in the United States and in other food processing countries. The second part is concerned with food processing in the lesser developed countries and in particular with a few countries which have been the beneficiaries of new technologies introduced by private foreign sources. The experience of our firm in the dairy industry both in the United States and in the underdeveloped areas where we have plants will illustrate how specific technologies have been made to work. My final interest is to suggest some practical opportunities that specific new technologies could afford for solving some of the basic problems.

FOOD PROCESSING-DESCRIPTION

3. Some of the objectives of food processing are:

   (a) To overcome dependence on seasonal or annual crop production and the concomitant feast or famine.

   (b) To minimize deterioration, spoilage and resulting waste.

   (c) To retain palatability and nutritional qualities of the food.

4. Foods are made available for longer periods of time by the use of:

   (a) Elevated Temperatures for the heat treatment required for:

      (i) Pasteurization.
      (ii) Sterilization, as in canning.

   (b) Lowered Temperatures for:

      (i) Cooling - as in the ordinary "ice box" or refrigerator.

(ii) Cold Storage - from -18°C to -23°C.
(iii) Freezing - -23° or lower, C.

(c) Removal of Moisture by one or more methods.

(i) Spray, or drum drying.
(ii) Baking.

(d) Harmless Additives (formerly and often still called preservatives) such as:

(i) Propionates in bread.
(ii) Sorbic acid in cheese.
(iii) Salting and brining.
(iv) Pickling (vinegar).

5. All of these methods succeed in inhibiting or destroying microorganisms, the major spoilage agents in food. The principal food processes, canning, freezing, and dehydration are designed to keep food in one or more of its usable forms. These methods are most efficient when raw foods of high quality are processed.

NEW PROCESSES

6. New processes which are being developed may have considerable impact on the future use of older methods. Briefly, these processes include:

(a) LIQUID NITROGEN FREEZING - Raw or precooked food is precooled with a spray of liquid nitrogen, then passed through an immersion bath of liquefied gas. The product is frozen to -18°C or lower in less than 5 minutes. Small pieces of food are frozen almost instantaneously. Rapidity of freezing is the distinctive advantage of liquid nitrogen over the conventional methods of freezing. There is promise too of new product development through ability to freeze foods which have defied successful freezing by any other method. Unless there is a low-priced source of liquid nitrogen available, the process is not economical. By-product liquid nitrogen is obtained usually from the manufacture of liquid oxygen.

(b) IRRADIATION OF FOODS - Food irradiation is a method which employs ionizing radiations to reduce or completely destroy the microorganisms responsible for most food spoilage. Electron beams (from linear accelerators, for example) and gamma rays (from radium, cobalt-60, or cesium-137) are used as sources of radiation. Irradiation of foods is still very much in the experimental stage. Progress is being made. However, we must remember that a complex technological innovation may require 15 to 20 years or more to go through its development period and reach general acceptance. The simple innovation of frozen foods took 15 years to get started. Considering historical precedents, food irradiation may not be off schedule. Among the several potential uses of irradiation for food processing are:

(i) Surface pasteurization of fresh foods in flexible packages. Shelf life of fruits, vegetables and meats is extended even under the usual handling conditions. Refrigeration of these irradiated foods further extends the shelf life. The low doses of energy used have little effect on the food's taste or physical makeup.

(ii) Sterilization of foods by use of high radiation dosage is not as promising as the pasteurization. Undesirable changes in color, taste, odor and texture must be overcome.

(iii) Other uses of irradiation that have been investigated include (A) inhibition of sprouting in stored potatoes and onions, (B) destruction of direct infestation in stored grains, spices, dried fruits and vegetables. As techniques

for irradiating food are perfected, highly seasonal perishables will be protected through pasteurization. Sterilization of foods by radiation eventually will become more important than pasteurization. Sterilized foods would be grocery-shelf items along with conventional canned goods.

(c) FREEZE-DRYING - The food to be dried is quick frozen. Drying is then carried out in a high vacuum, the process permitting rapid conversion of the water from the frozen into the vapor state without going through the liquid phase. Moisture is lost from the surface of the food leaving a porous product which greatly facilitates rehydration when the food is prepared for consumption. Drying foods at low temperatures minimizes bacterial growth, enzyme activity, and undesirable chemical changes. Damage to color, flavor and texture is low. The reconstituted food is superior in these respects to conventionally dried or concentrated products and generally equal to frozen foods. Freeze-dried foods need no refrigerated storage, weigh less because of the loss of moisture, and are easier to handle than foods processed by other methods. Freeze-dried foods do not have to thaw but merely be rehydrated before cooking or serving. Before this process becomes widespread, cost of processing equipment must be reduced; freezing rates determined to improve rehydration; drying times reduced.

(d) DEHYDRO-FREEZING - The method consists of partial dehydration followed by freezing of the food. Food is dried in a hot air stream to approximately 50% of its original weight, then quick-frozen. Storage requires deep freeze temperatures. Rehydration is needed at the time of use. Conventional dried fruits and vegetables, while the least costly, suffer serious quality losses in drying and storage. Frozen foods have excellent quality but also high costs. The combination of these two processes into dehydro-freezing has several distinct advantages: -- Less bulk, weight, drip and better moisture control in remanufacturing than frozen products; easier and more complete rehydration, better color, flavor, texture and lower sulfite levels than dried products. The method is applicable to a number of foods. Currently it is applied commercially to apple slices, peas and the major citrus juices.

(e) FOAM-MAT DRYING - This method involves making a stiff foam by whipping air or an inert gas into a concentrated foodstuff in the presence of an edible foam stabilizer. The stabilized foam is deposited as a uniform layer onto perforated trays; the trays pass over an air blast to perforate the foam and thus greatly increase the surface available for heat transfer and evaporation of water. This perforated mat of foamed food concentrate then passes through a dryer which decreases product moisture to 2 to 2.5%. Materials that have been foam-mat dried include water infusions of tea and coffee, fruit purees, and extracts of beef and chicken. Flavor and color of these foam-mat products are reported to be superior to those dried by other methods. The process obviously is limited to liquids and concentrates as foaming is required. It is not suited to products sensitive to oxygen in the drying air. Volume and weight reduction of the dried food is approximately the same as with spray and drum dried foods.

(f) ASEPTIC CANNING - This treatment of foods that have been sterilized by a high-temperature, short-time process is receiving a great deal of attention in several countries. The high-temperature, short-time sterilizing process in conjunction with aseptic canning minimizes the heat damage that accompanies traditional long-time processing of food. The new method retains more of the desirable properties of foods. In addition, large containers - we have used 210 liter drums - can be sterilized and filled aseptically. Foremost Dairies has pioneered in the research and commercial application of these processes. Milk, evaporated milk, processed cheese, fruit juices, and similar products processed by this method provide a more natural tasting and more nutritious product than the same foods processed by conventional canning methods.

THE VALUE OF THE FOOD PROCESSING INDUSTRY TO A COUNTRY

7. In the countries of Western Europe, North America, Oceania, and Japan, the food processing industry (through technical progress) has brought many benefits, in addition to plentiful and wholesome food. A smaller proportion of the population is engaged in producing foodstuffs on the farm. Basically, food processing and the allied technologies required to keep it efficient prevent the loss of the food that is produced. Thus the efforts of more members of a well-fed population can be directed to providing manufactured products and services. These are the material things that lead to what is called a better standard of living.

8. The improved nutrition and resulting better health and well-being of the people have brought pronounced increases in the productivity of labor, technical achievement, and economic activity. (Figure I lists a few characteristics of the food processing countries. Figure II gives the output of processed food in various countries.)

9. In considering the dietary (or nutritional) status observed in the technologically less-developed countries, the relationship and importance of food and food processing to man's well-being becomes more clearly defined. The acceptance of initial technical help from outside sources can be the catalyst to a continuing and expanding technological achievement in the developing country.

DIRECT APPLICATION OF FOOD TECHNOLOGY TO DEVELOPING COUNTRIES

10. I would like to discuss the part our industry, the dairy industry, has played in improving the well-being of people in developing countries. A study of the dietary needs of these countries shows that additional protein and vitamins would be of material benefit. Benefit in two ways: (1) preventing and eliminating clinical symptoms of protein and vitamin deficiency and (2) maintaining a better nutritional status in the well person. Milk is widely considered one of the best of foods. The biological value of its protein is seldom equalled in any other food. It is unique in its variety of minerals. With its complement of carbohydrate, fat and vitamins, one can see why milk is referred to as "nature's most nearly perfect food."

11. The approach needed in establishing modern dairy facilities in a developing country depends to a great extent on local conditions:

(a) No appreciable dairying - Establish a plant for "recombined whole milk" and milk products.

(b) Small amount of dairying - Establish a plant for recombined milk, and as dairy herds increase in size integrate the use of the fresh and recombined milks.

(c) Developed dairying - Here the local supply of fresh milk is processed. The ingredients for recombined milk, if economical to use in comparison to local milk, are used in milk products other than fluid milk.

12. Since 1946, recombined milk has been used to supply fresh-tasting fluid milk and milk products to areas lacking an adequate supply of dairy foods. Fresh whole milk is separated. The skim milk is dried. The milk fat is dehydrated to practically 100% milk fat. These two parts of milk are processed and packaged separately and therefore have an excellent storage life. At destination the two parts of milk are recombined with purified water, homogenized, pasteurized, and filled into bottles or cartons. Distribution is carried out in the usual manner.

13. Fortunately, as development of the local dairy herds progresses, it is relatively simple to adapt the recombined milk plant to a fresh milk operation. The

majority of the equipment is the same in both type plants. Fresh milk handling requires only the addition of incoming milk holding and cooling tanks.

(a) Thailand

(i) Our experience in Thailand is an excellent example of cooperative achievement by a private foreign company, the Thai government, and local interests. In 1956, when our company entered this project, fresh milk was not consumed in Thailand and no local dairy industry existed. There were, however, considerable quantities of sweetened condensed milk imported into the country.

(ii) In the intervening years, this project has been successful in making available a broad range of dairy products. The infant dairy industry is supplying its first fresh milk and shows every indication of healthy growth. There is an increasing consumption of fluid milk and ice cream in Bangkok. In reflecting on this progress in Thailand, it becomes obvious that the country is realizing a better nutritional status, an expansion of technical skills in several fields, a broadened perspective and economic goals. Other than a few of our industry's technicians, all of the employees in the dairy project are Thai citizens.

(iii) This partnership effort is aided significantly by the Thai government, which provides a climate for enterprise and individual incentive. Recently the Thai government has approved construction of other dairy plants which will utilize locally produced sugar and other materials.

(b) Japan

(i) In 1947 milk drinking in Japan was not popular - especially among men. Our company's primary job in Japan was to supply the Americans living there with recombined milk products. In our plants, the personnel were Japanese citizens whom we trained in dairy technology. Also, we provided technical assistance to the established dairy processors. The stimulus has resulted in the establishment of the Japan Dairy Council. This group is carrying out an educational program on the nutritive value of milk. In a ten year period, imports of dried skim milk increased 1200%. Their own domestic milk production increased over 700%. The net result of these operations has been a tremendous increase in the consumption of milk by the Japanese, a betterment of the nutritional status of the people, and a growth in their dairy industry.

(c) Venezuela

(i) In those countries where milk and milk products are an estaolished part of the dietary habits of the people, the fresh fluid and powdered milk industries can be developed further within the country. This has happened in a spectacular manner in Venezuela through the combined efforts of: a) a private foreign dairy company supplying the technology; b) local interests; and c) well planned help to the dairy farmers by the Venezuelan government.

(ii) In 1949, when our firm, in conjunction with the International Basic Economy Corporation and Venezuelan farmer investors, began operations, fluid milk consumption was less than ten million liters per year. Today this project has grown to six plants across the country. Fresh milk consumption has reached over three hundred million liters and is still increasing. Dried milk production, which has been encouraged by other private foreign companies and ourselves, has risen from three million pounds in 1945 to thirty million pounds in 1960.

(d) India

(i) The "Bombay milk project" is an excellent example of well managed efforts by: a) the state and city government of Bombay, and b) international resources. The project is well deserving of the publicity given it. At the time it was started none of the milk available to Bombay consumers was subject to modern processing.

(ii) The over-all operation centralized and coordinated the production, processing, distribution and pricing of milk and milk products. In spite of the growth of the project and increase in processing facilities, the supply of milk did not meet consumers' needs. To help meet this need, and meet it economically, the project introduced "toned" milk - a form of recombined milk.

(iii) Buffalo milk (7.5% fat; 9.3% solids not-fat) is recombined with skimmed milk solids and water to provide a fluid milk of 3.5% fat and 9% solids not-fat. The project has assured a safe source of wholesome and nutritious milk for a sizeable number of Bombay consumers.

(iv) Thus the "toned" milk provides a method of distributing the high fat buffalo milk into a nutritionally more balanced product.

CONCLUSIONS

14. From the several examples of successful efforts between private outside technical resources, local government, and local industrial interests that have been discussed, the time-tested and practical method for bringing food technologies and related skills to an interested country is through a partnership working arrangement between:

(a) The government of the interested country creating incentives and assisting in promotion of private industrial development,

(b) local resources and local initiative of individuals of the interested country, and

(c) a private outside source of talent thoroughly versed and knowledgeable in the desired technology.

FIGURE I

SELECTED CHARACTERISTICS OF CERTAIN PROCESSING COUNTRIES

INDICATOR	Unit	Year	COUNTRY							
			United States	Canada	United Kingdom	France	Germany	Italy	Nether-lands	Japan
National Income - per capita[a]	$ U.S.	1960	2,297	1,540	1,084	961	967	509	804	341
Personal Consumption Expenditure - Proportion of GNP[b]	%	1960	64	65	66	65	n.a.	63	56	54
Food Expenditure as Portion of Personal Consumption Expenditures[c]	%	1960	21	20.7	32.7	37.8	33.6	46.5	33.7	47
Labor Force - Agriculture[d]	%	1961	7.6	13.4	4.3	27.6	16.2	30.4	20.7	40.1
Labor Force - Manufacturing	%	1961	32.8	35.1	47.6	36.1	47.7	37.1	35.7	24.0
Labor Force - Services	%	1961	59.6	51.5	48.1	36.3	36.1	32.5	43.6	35.9
Fertilizer Usage per capita[e]	Kgs.	1959	38.1	15.8	24.4	43.1	44.2	17.3	36.8	166.8
Tractors in Use[f]	No.	1959	4,770,000	399,686	433,870	626,500	778,003	225,224	64,200	650
Caloric Consumption - per capita, per day[g]	No.	1959/60	3,130	3,150	3,290	2,940	2,890	2,710	2,970	2,210
Protein Consumption - per capita, per day	Grams	1959/60	93	96	87	98	78	79	80	68
Animal Protein - per capita, per day	Grams	1959/60	66	64	52	52	46	27	45	18
Food Supplies Available for Consumption										
Cereals	%	1959/60	9.4	10.7	13.1	15.5	13.8	25.6	13.0	40.0
Starchy roots	%	1959/60	6.7	9.6	13.6	14.5	22.6	9.5	13.7	17.3
Sugar	%	1959/60	5.8	6.8	7.8	4.6	4.4	3.6	6.0	3.7
Pulses	%	1959/60	.9	.8	.9	1.0	.7	2.3	.6	4.8
Vegetables	%	1959/60	13.8	11.7	9.2	18.6	6.5	24.9	9.4	19.0
Meat	%	1959/60	13.4	12.4	11.0	10.7	8.8	4.9	6.7	1.6
Eggs	%	1959/60	2.8	2.4	2.3	1.6	2.1	1.4	1.8	1.1
Fish	%	1959/60	.7	.9	1.6	.7	1.1	.7	.8	6.1
Milk[h]	%	1959/60	43.6	41.6	36.7	30.1	35.8	24.1	44.1	5.3
Fats	%	1959/60	3.0	3.0	3.4	2.5	4.7	2.9	3.8	1.1

a. United Nations Statistical Yearbook, 1961. Estimates derived from official population and national income data of respective countries.

b. Ibid.

c. United Nations, Yearbook of National Accounts Statistics, 1961.

d. United Nations Statistical Yearbook, 1961.

e. Foreign Agriculture Organization, Production Yearbook, Vol. 14, 1960.

f. Ibid.

g. Food and Agriculture Organization of the United Nations. The State of Food & Agriculture, 1961 Unit d States and Japan data for 1959.

h. Milk and milk products estimated in terms of liquid milk.

FIGURE II OUTPUT OF PROCESSED FOODS (OUTPUT IN THOUSAND METRIC TONS)

	Whole Milk Equivalent Per Capita Consumption lbs.[b]	Fluid Milk	Condensed Evaporated Milk[c]	Nonfat Dry Milk	Butter	Cheese	Meat	Wine	Beer
WORLD (Output)[a]		335,600	2,282	1,369	4,776	1,943	55,900	239,000	381,000
		% of Total	% of Total	% of Total	% of Total	% of Total	% of Total	% of Total	% of Total
North America	n.a.	19					23	3	34
South America	n.a.	6					9	9	3
Europe	n.a.	38					25	72	49
Asia and Near East	n.a.	12					2		3
Africa	n.a.	3					2	11	1
Oceania	n.a.	4					4		3
SELECTED COUNTRIES									
United States	653	17	42.8	66.3	14.0	37.4	22	4	28
Canada	894	2	6.7	6.9	3.3	2.7	1		3
United Kingdom	835	3	8.1	4.7	1.0	5.8	3		11
France	853	6	4.5		4.6	17.2	4	25	5
Germany	803	6	16.9	6.0	8.9		4	2	12
Italy	449	2						28	
Netherlands	725	2	17.6	4.6	2.0	10.3			
Japan	32		2.4						2
Argentina	n.a.	1	3.0				4	7	
Brazil	n.a.	1					3		2
Australia	966	2		2.8	4.0	2.7			3
New Zealand	1,320	2		3.1	4.5	5.1			
Mexico	207								
Venezuela	310	4							
India	130	6							
Pakistan	103	2							

	Wheat Flour	Sugar	Margarine	Olive Oil	Canned Deciduous Fruit 000 Cases 24/2-1/2's	Canned Fish	Salted Fish	Animal Feeds
WORLD (Output)[a]	47,387	49,223	3,480	1,230	88,718	1,010	1,309	2,316
	% of Total	% of Total	% of Total	% of Total	% of Total	% of Total	% of Total	% of Total
North America	29	27	23			25	5	36
South America	10	12				8	3	15
Europe	49	22	60	78		32	38	26
Asia and Near East	8	16	19	7		15	15	12
Africa	2	6				9		9
Oceania	3	5	1					
SELECTED COUNTRIES								
United States	24	5	21		72	27	4	36
Canada	4		2		3	3	1	
United Kingdom	8	2	10		3	1		5
France		2	3			8	4	
Germany	7	3	17		3	10	4	4
Italy		5		23		2	2	
Netherlands	1	1	7			1	3	3
Japan	5		1		3	10	10	12
Argentina	3	2						
Brazil	4	6				2	2	
Australia								
New Zealand								
Mexico								
Venezuela								
India								
Pakistan								

Source: Food Engineering, July, 1962. Data for year 1959. Percentages are rounded; less than 1% not given.

a. Excludes U.S.S.R. World total includes some countries not included in specified regions.

b. National Dairy Council How Americans Use Their Dairy Foods, 1962. Japan - U.S.D.A. Impact of U.S. Nonfat Dry Milk in Japan 1948-59, June, 1960, p.9.

c. All other data on dairy products taken from U.S. Department of Agriculture, Foreign Agricultural Circular, May, 1962.

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